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## Improvised Explosive Devices in Iraq: Effects and Countermeasures

Clay Wilson

Specialist in Technology and National Security  
Foreign Affairs, Defense, and Trade Division

### Summary

Improvised explosive devices (IEDs) are responsible for many of the more than 2,000 deaths and numerous casualties suffered by U.S. and coalition forces since the invasion of Iraq.<sup>1</sup> The bombs have been hidden behind signs and guardrails, under roadside debris, or inside animal carcasses, and encounters with IEDs are becoming more numerous and deadly. The threat has expanded to include vehicle-borne IEDs, where insurgents drive cars laden with explosives directly into a targeted group of service members. DOD efforts to counter IEDs have proven only marginally effective, and U.S. forces continue to be exposed to the threat at military checkpoints, or whenever riding in vehicles in Iraq. DOD reportedly expects that mines and IEDs will continue to be weapons of choice for insurgents for the near term in Iraq, and is also concerned that they might eventually become more widely used by other insurgents and terrorists worldwide. This report will be updated as events warrant.

### Background

Improvised explosive devices, or IEDs, now cause about half of all the American combat casualties in Iraq, both killed-in-action and wounded.<sup>2</sup> The Iraqi insurgents make videos of exploding U.S. vehicles and dead Americans and distribute them via the Internet to win new supporters. Outside Iraq, foreign radicals see the images as confirmation that the Americans are vulnerable. IEDs are also killing hundreds of Iraqis as insurgents also strike police stations, markets, and mosques. The latest innovation involves the aggressive use of vehicular bombs, two-thirds of which are driven by suicide bombers.

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<sup>1</sup> Albert Eisele, "Improved Explosives Becoming More Deadly in Iraq," *The Hill*, March 28, 2005, [<http://www.hillnews.com/thehill/export/TheHill/News/Iraq/explosives1.html>].

<sup>2</sup> Loren B. Thompson, *Iraq: Stop the Bombers, Win the War*, Lexington Institute, June 10, 2005, at [<http://www.lexingtoninstitute.org/defense.asp?aid=616>].

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An Improvised Explosive Device is a “homemade” mine designed to cause death or injury by using explosives that are hidden and set off using a variety of trigger mechanisms. IEDs can utilize commercial or military explosives, or homemade explosives, and often the IED builder has had to construct them with the materials at hand.<sup>3</sup> IEDs could also possibly be used in combination with toxic chemicals, biological toxins, or radiological material, but so far this has not been reported in Iraq.

Some observers speculate that munitions for constructing IEDs may be coming from a large supply of unexpended Iraqi military ordnance that was gathered and stockpiled in secret locations throughout Iraq. In April 2003, Iraqi looters stormed the Al Qaqaa military weapons site and possibly carried off nearly 400 tons of powerful conventional explosives, after the site was first abandoned by Iraqi forces and then left unsecured by U.S. forces. It is not known exactly when the munitions may have vanished from the site, and it is possible that Iraqi forces may have removed and relocated some explosives before the invasion.<sup>4</sup>

Insurgents have constructed IEDs powerful enough to kill soldiers inside 22-ton Bradley Fighting Vehicles. In one incident in 2004, after a Bradley ran over a large IED, the armored bottom plate of the vehicle was reportedly found some 60 yards from the site of the explosion.<sup>5</sup> In contrast, military units equipped with the 19-ton Stryker medium-weight armored vehicle, have reportedly suffered a lower number of catastrophic vehicle losses due to enemy attack. With a maximum speed of more than 60 mph, the Stryker can dash past ambushes and roadside IEDs that might catch the slower moving Abrams tank and Bradley.<sup>6</sup> Between December 2003 and October 2004, news reports show that Strykers deployed in Iraq have successfully withstood 56 attacks by IEDs. Even when vehicles were rendered inoperable by the attacks, there was reportedly no loss of life among the Stryker crews.<sup>7</sup>

Triggering methods for IEDs may include using a cell phone, a garage door opener, or a child’s remote-control toy, or may even be as simple as running over a rubber hose to produce enough air pressure to activate a switch for a mine. At other times, the insurgent may remain concealed and trigger an IED manually. The following techniques describe how insurgents can design and deploy IEDs to amplify the damage:

- **Coupling.** Coupling is a method of linking one mine or explosive device to another, usually with detonating cord. This technique is often used to

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<sup>3</sup> Definition from Global Security.org, at [<http://www.globalsecurity.org/military/intro/ied.htm>].

<sup>4</sup> James Glanz, Jim Dwyer, *Looting Spree Gutted Ammo Dump*, San Francisco Chronicle, October 28, 2004. Byron York, *Remember Al Qaqaa?*, National Review Online, February 28, 2005, [<http://www.nationalreview.com/york/york200502280821.asp>].

<sup>5</sup> Daniel Goure, *The Power in a Single Picture*, October 14, 2004, Lexington Institute, [<http://www.lexingtoninstitute.org/defense.asp?aid=432>].

<sup>6</sup> Daniel Goure, *Better than an Abrams*, May 28, 2004, Lexington Institute, [<http://www.lexingtoninstitute.org/defense.asp?aid=38>].

<sup>7</sup> Daniel Goure, *The Power in a Single Picture*, October 14, 2004, Lexington Institute, [<http://www.lexingtoninstitute.org/defense.asp?aid=432>].

defeat countermeasure equipment. A heavy mine roller will pass over the initial, unfused device and set off the second fused device. This in turn detonates the overpassed device underneath the clearing vehicle.

- **Boosting.** Buried mines, or other explosive devices are stacked on top of one another. The topmost explosives are non-metal, and only the device buried deepest from the surface is fused. This reduces the probability of detection, and it increases the force of the blast.
- **Daisy chaining.** IEDs may be linked together along a roadway with trip wire or detonating cord. When the initial mine is detonated, the other mines also detonate.<sup>8</sup>
- **Shaped Charges.** A cylindrical container is closed off at one end, packed with explosive, and capped by a conical piece of metal that becomes a molten projectile when the device is detonated. The shaped charge concentrates blast energy to punch through armor plating, and then propels the molten metal into the vehicle's cabin.<sup>9</sup>

Some friendly fire incidents may also be occurring because of tensions owing to insurgents' use of vehicle-borne IEDs. For example, private security contractors driving vehicles in Iraq have reported that from January to May 2005, they may have been mistakenly fired upon by U.S. forces at least 20 times as they approached U.S. military convoys and checkpoints.<sup>10</sup>

## Countermeasures

The U.S. military has increased the quality of armor used for vehicles in Iraq, including up-armoring the High-Mobility Multi-Purpose Wheeled Vehicles (HMMWV, or Humvees). However, as an apparent response to use of more heavily armored vehicles, insurgents have developed even more powerful IEDs, along with more sophisticated methods for deploying and triggering them.<sup>11</sup>

The Army has also established an anti-IED task force directed by Brigadier General Joseph L. Votel to analyze methods for neutralizing IEDs. Because insurgents in the recent past have quickly adapted their tactics to avoid new U.S. countermeasures, the group will also study ways to eliminate sites where IEDs are manufactured in Iraq.

The Pentagon is also searching for new technologies to help find and neutralize IEDs. Microwave blasts, radio-frequency jammers, and chemical sensors are among the

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<sup>8</sup> Global Security.org, at [<http://www.globalsecurity.org/military/intro/ied.htm>]

<sup>9</sup> John Anderson, Steve Fainaru, Jonathan Finer, "Bigger, Stronger Homemade Bombs Now to Blame for Half of U.S. Deaths," *The Washington Post*, October 26, 2005, p. A1.

<sup>10</sup> GAO-05-737, July 2005, *Rebuilding Iraq: Actions Needed to Improve Use of Private Security Providers*.

<sup>11</sup> John Anderson, Steve Fainaru, Jonathan Finer, "Bigger, Stronger Homemade Bombs Now to Blame for Half of U.S. Deaths," *The Washington Post*, October 26, 2005, p. A1.

different methods being explored and deployed in this effort. Examples of electronic jamming systems mounted on military vehicles include the IED Countermeasures Equipment (ICE) and the Warlock, which use low-power radio frequency energy to block the signals of radio controlled explosives initiators, such as cell phones, satellite phones, and long range cordless telephones.<sup>12</sup> The Army has recently ordered thousands of these radio-frequency jammer devices. However, experts reportedly caution that the jammers may only be partially effective because they must be set to operate within the right frequency range in order to stop an IED.

Some experts believe that a more effective IED countermeasure might be achieved through technology that can detect IEDs from afar, and then create a pulse of electromagnetic energy to prematurely detonate them, or burn out and destroy their circuitry. Researchers at the Naval Surface Warfare Center's Dahlgren Laboratory in Virginia are working on such a solution, called Neutralizing Improvised Explosive Devices with Radio Frequency (NIRF). The device, according to a source familiar with the project, produces a very high-frequency field at very short range that can neutralize an IEDs electronics. The Pentagon reportedly will deploy NIRF in Iraq later this year.<sup>13</sup>

Military contractors are also working on a ways to create a protective area around moving convoys.<sup>14</sup> A Pentagon microwave project, code-named PING, is already deployed in Iraq, and reportedly has been successful at helping locate insurgent weapons caches. The machine, which fits inside a Humvee, sends out electromagnetic waves that can penetrate a building's interior to detect IEDs. Other sensors, such as the Laser-Induced Breakdown Spectroscopy system (LIBS), are being developed to detect traces of explosives used for IEDs from as far away as 30 meters.<sup>15</sup>

The "Talon" is a bomb-disposal Unmanned Ground Vehicle (UGV), or robot, that comes equipped with a mechanical arm to pick up and inspect dangerous objects, such as suspected IEDs. More than a hundred of the remote-control robots are now being used in Iraq and Afghanistan, with an equal amount on order. Another robot, called the "PackBot" has also been used by the Army to clear bombs and explore suspected terrorist hideouts.<sup>16</sup>

Threat data about IEDs, including technical details on how insurgents build the devices, is tightly controlled by DOD. Also, proprietary rights must be protected for those companies who produce IED countermeasures, which limits the distribution to other

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<sup>12</sup> Sgt. Stephen D' Alessio, 2<sup>nd</sup> Marine Division, *Marines schooled in new bomb protection*, July 7, 2005, [<http://www.marines.mil/marinelink/mcn2000.nsf/0/b89628064c45144e85257056003871f1?OpenDocument>].

<sup>13</sup> Christopher Castelli, "General: Ability to Prematurely Detonate Enemy Bombs Badly Needed," *Inside the Navy*, August 22, 2005, at [<http://www.insidedefense.com>].

<sup>14</sup> Loren B. Thompson, *Iraq: Stop the Bombers, Win the War*, June 10, 2005, Lexington Institute, [<http://www.lexingtoninstitute.org/defense.asp?aid=616>].

<sup>15</sup> Sebastian Sprenger, "U.S., NATO Research Could Help Troops Detect IED Threats from Afar," *Inside the Pentagon*, May 26, 2005. Noah Shachtman, "Improvised Bombs Baffle Army," *Wired News*, January 26, 2005 [<http://www.wired.com/news/technology/0,1282,66395,00.html>].

<sup>16</sup> Noah Shachtman, "Improvised Bombs Baffle Army," *Wired News*, January 26, 2006, [[http://www.wired.com/news/technology/0,1282,63036,00.html?tw=wn\\_story\\_related](http://www.wired.com/news/technology/0,1282,63036,00.html?tw=wn_story_related)].

companies of some reports that evaluate the effectiveness of anti-IED systems in battle and during testing.<sup>17</sup> As a result, some industry observers say they are not getting access to all the information they need to find solutions to counter IEDs. Some observers also complain that if information on how enemies build IEDs is released, other insurgents could possibly learn how to construct even more of the devices. But others say there is also a strong likelihood that release of technical information will prompt industry to find more solutions that will make the IEDS weapons less deadly.<sup>18</sup>

## Acquisition of Countermeasures

According to press reports, approximately 10,000 Humvees now in Iraq that were not armored for combat conditions are currently re-enforced using steel plates that might not withstand the increasingly powerful explosives being used by the insurgents.<sup>19</sup> A recent GAO report also indicated that acquisition delays may have increased the vulnerability of U.S. forces to the IEDS threat, stating "... specific problems delayed DOD's acquisition of three important items we reviewed (Interceptor body armor, lithium batteries, and up-armored High-Mobility Multi-Purpose Wheeled Vehicles). DOD's acquisition decision did not maximize available capacity to produce up-armored High-Mobility Multi-Purpose Wheeled Vehicles and add-on armor kits nor did it give Congress visibility over the basis for its acquisition solution. These acquisition challenges impeded DOD's ability to respond to rapidly increasing demands. To minimize acquisition delays in the future, we recommend the Army and Defense Logistics Agency assess the industrial-base's capacity to meet updated requirements for critical items within the time frames required by operational plans and provide visibility to Congress over acquisition of critical items that emerge during contingencies."<sup>20</sup>

Actions taken by DOD to minimize future acquisition delays reportedly include adhering to Army Regulation 700-90, originally dated December 2004, describing policy for the Army's Industrial Base Process which requires that the Army publish hardware priorities, war reserve stocks, and industrial preparedness measures that support war replenishment objectives and the Army's Critical Items List. The Army has also implemented a "Rapid Fielding Initiative" (RFI) to ensure that soldiers have the latest available equipment. Information on the acquisition of critical go-to-war items is reported to Congress annually through the Industrial Capabilities Report to Congress.

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<sup>17</sup> Michael Moss, "Many Missteps Tied to Delay Of Armor to Protect Soldiers," *The New York Times*, March 7, 2005, at [<http://www.globalsecurity.org/org/news/2005/050307-armor-missteps.htm>].

<sup>18</sup> Anne Plummer, "Deadly Threat of Explosive Devices in Iraq Prompts Secrecy Debate," *Inside the Pentagon*, November 18, 2004, vol. 20, no. 47.

<sup>19</sup> Michael Moss, "Many Missteps Tied to Delay Of Armor to Protect Soldiers," *The New York Times*, March 7, 2005, at [<http://www.globalsecurity.org/org/news/2005/050307-armor-missteps.htm>].

<sup>20</sup> *Defense Logistics: Actions Needed to Improve the Availability of Critical Items during Current and Future Operations*, GAO-05-275, April 8, 2005.

## Funding for Countermeasures

The Joint IEDS Defeat Task Force has reportedly spent \$378 million since 2003 to buy electronic jammers to counter IEDs. However, funding to purchase anti-IEDS electronic jammers has reportedly traditionally come through congressional plus-ups and reprogramming actions, and not through ordinary line-item funding in the fiscal year budget.<sup>21</sup>

On April 30, 2005, the Army was granted “rapid acquisition authority” by Defense Secretary Donald Rumsfeld, meaning that the traditional DOD acquisition process could be set aside, allowing a manufacturer of a special, man-portable IEDS jammer device to be chosen within only a 15 day time period.<sup>22</sup> The Pentagon plans to purchase 10,000 of the devices, at \$1,000 each. On May 24, 2005, Congress approved a transfer of \$129.7 million from the Iraqi Freedom Fund to purchase mobile, multiband Warlock jammers which can detect threats concealed on people and in vehicles, and to support R&D and deployment for other anti-IEDS devices.<sup>23</sup> On July 13, 2005, a reprogramming action transferred \$10 million out of Iraqi Freedom Fund for two new anti-IEDS systems: \$3.5 million for 50 Small, Lightweight Advanced Modular Digital Electronic Protection Systems (SLAM-DEP), which incorporates existing jammer technology into a wearable vest, and \$6.5 million to purchase 187 low-cost, expendable robots designed for explosive ordnance disposal.<sup>24</sup>

The Senate version of the Department of Defense Authorization Act for Fiscal Year 2006 (**S. 1043**), passed on November 15, 2005, authorizes \$500,000,000 of the Iraq Freedom Fund solely for support of the Joint IEDS Task Force. The House version of the National Defense Authorization Act (**H.R. 1815**), passed on May 25, 2005, contains no similar provision.

The Department of Defense Appropriations Act, 2006, as amended by the Senate (**H.R. 2863.EAS**), earmarks \$750,000,000 from the Iraq Freedom Fund for the Joint IED Defeat Task Force. The version passed by the House (**H.R. 2863.EH**) contains no similar provision.

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<sup>21</sup> Jen DiMascio, “Pentagon Transfers \$160 Million to Buy Protection Equipment,” *Inside the Army*, January 17, 2005.

<sup>22</sup> Glenn Maffei, “Defense Officials Worry Insurgents Will Change IEDS Tactics, Tech,” *Inside the Army*, May 9, 2005.

<sup>23</sup> Jen DiMascio, “Congress OKs \$129.7 Million Transfer to Fund IEDS Countermeasures,” *Inside the Army*, May 30, 2005.

<sup>24</sup> Glenn Maffei, “Order Made for Final “Warlock” Batch to Tackle IEDS Problem in Iraq,” *Inside the Army*, July 25, 2005.